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Farmer Attitudes Toward Technological Changes Affecting Grain Handling and Quality

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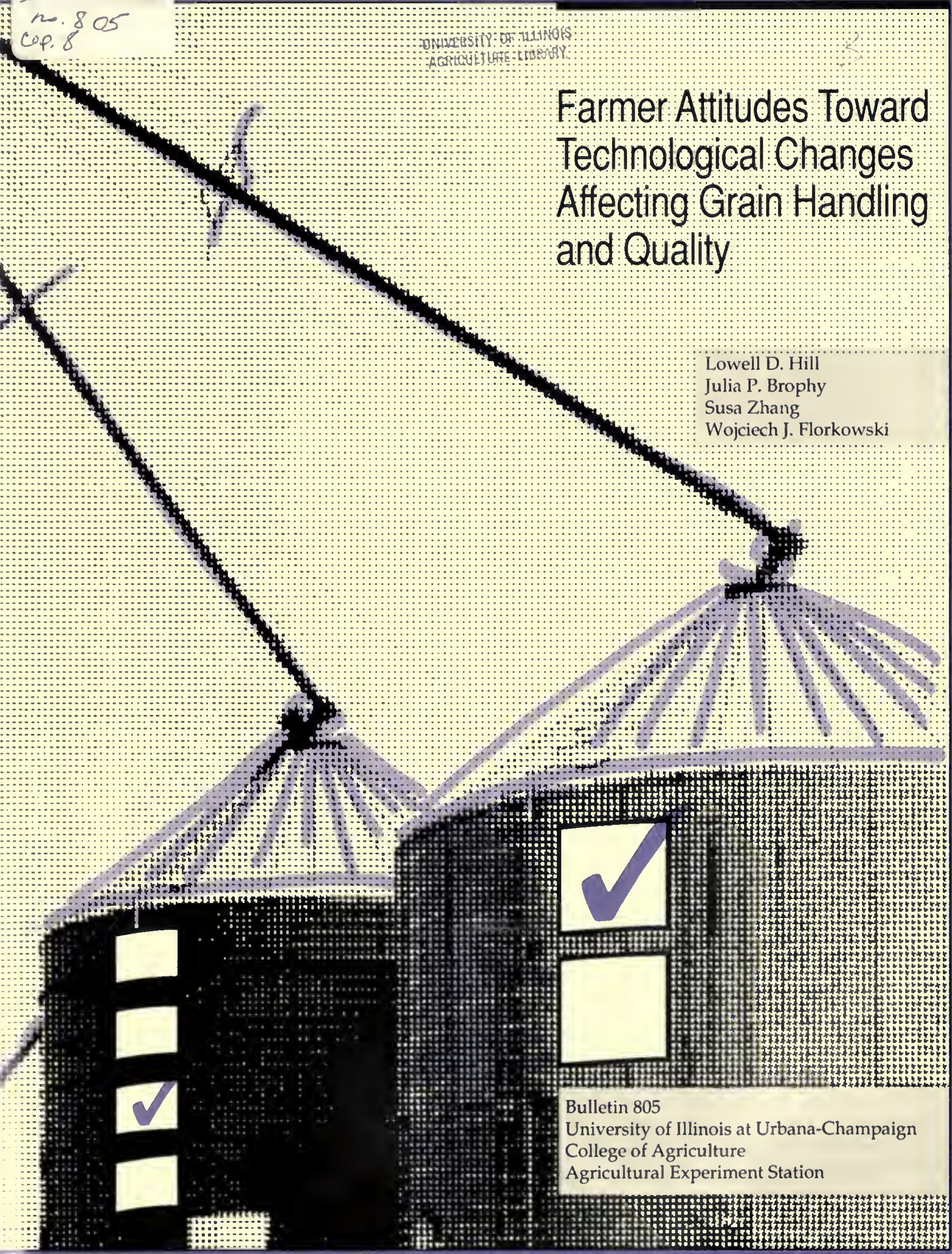

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Introduction

Current Quality Concerns. United States grades and standards have undergone numerous changes since the passage of the Grain Standards Act in 1916. Most of these regulatory changes have dealt with definitions of terms and changes in factor limits. In addition, three major pieces of legislation amended the original Grain Standards Act, altering the philosophy and procedures in grain grading and inspection. Several additional regulatory and legislative changes are currently being considered (Hill 1990b).

Support for changes in grades has come from many sources, and nearly all proposals for change have been challenged by one or more groups in the industry. Legislation and regulatory changes have often been justified by identifying potential benefits to producers. The identification of these benefits has been made, in many cases, by nonproducer organizations and individuals purportedly speaking on behalf of farmers. Farmers also exert important control over quality through their production and marketing decisions. The probability that proposals for grade changes will be implemented is increased if they are supported by producers and their representatives. Producer organizations have been vocal influences in the development of grain grading legislation and subsequent changes.

In spite of the importance of producers' support for changes in grades and their actions to improve quality, little information is available about the attitudes of individual farmers toward the changes and proposals for change or about the technology and practices that influence quality. The purposes of this study were to identify on-farm technology related to grain quality, to identify farmers' attitudes toward changes in grain grades, and to determine if these attitudes have changed over time.

Technology Choices that Influence Quality. The quality of grain can be improved by changing on-farm harvesting, cleaning, drying, and storage practices. Farmers can adjust their combines to reduce foreign material in grain to be stored on farms, or leave additional foreign material in grain that will be delivered into the market. Proper adjustment of combines can reduce kernel breakage. There are many alternative technologies for cleaning grain prior to storage or during removal from storage. Alternative drying systems create many differences in final quality. These and other technological alternatives available to farmers influence grain quality and storage life, as well as affect quality at subsequent points in the market channel.

The method of drying is one of the most important technology choices affecting corn quality. The beneficial effects of low-temperature drying technologies on corn quality have been frequently documented (Hill, Brophy, and Florkowski 1987; Gunasekaran and Paulsen 1985). Lower kernel temperatures in combination with slower rates of moisture removal and slower rates of cooling result in higher test weight, higher yield of flaking grits, fewer stress cracks in the kernels, lower breakage susceptibility, and greater solubility of the starch. The improvement in quality and the additional advantage of reduced fossil fuel requirements for drying under low or no heat have encouraged some farmers to adopt the low-temperature drying techniques (Schwart 1982).

Farmers use several technologies for storing grain including ear corn cribs, cribs converted to shelled corn, metal bins, and silos. These storage alternatives are interdependent with the choice of drying technology. Corn stored in ear corn cribs is usually harvested at moisture levels below 19 percent, so that drying, other than ambient air, is seldom required. Corn harvested with field shellers or combines usually requires some form of drying before storage, unless the wet corn is stored in silos for on-farm feeding. Shelled corn stored in metal bins or converted cribs usually requires drying. Some dryers are an intergral part of the storage bin; other dryers are separate units.

Market Demand for Quality. The market for high-quality corn produced by low-temperature drying is not well developed because a large dependable supply has not been available. Because buyers have not offered consistent premiums, producers have been slow to change technologies. Before buyers will offer premiums for superior qualities, processors and foreign importers must be assured of a dependable supply from multiple sources. Several studies have identified the increased value of quality to the wet and dry milling industries (Weller, Paulsen, and Steinberg 1988; Litchfield and Shove 1989), although the quantities of corn used by these industries are relatively small (Leath, Meyer, and Hill 1982). These observations suggest a theoretical demand curve for high-quality corn along which the quantity demanded increases rapidly as the price premium declines (Figure 1). No aggregate data exist from which to derive the demand curve, but the maximum value of quality in each of the processes and the quantity used by each industry suggest only a small percentage of the total supply would be able to command high premiums. However, since all firms prefer whole kernels to broken kernels at equal prices, the shape of the curve is supported by logic, if not by data.

Each of the major industries using corn has a different premium threshold below which it will start using the higher quality corn. The total consumption of corn (Q_t) is allocated among four major uses—dry milling, wet milling, feed manufacturing, and exports (Figure 1). Dry milling uses about 4 percent of production; wet milling about 10 percent; feed manufacturing about 60 percent; and exports about 25 percent. The percentages vary from year to year with changes in production, but the quantities used by the processing industries remain fairly constant.

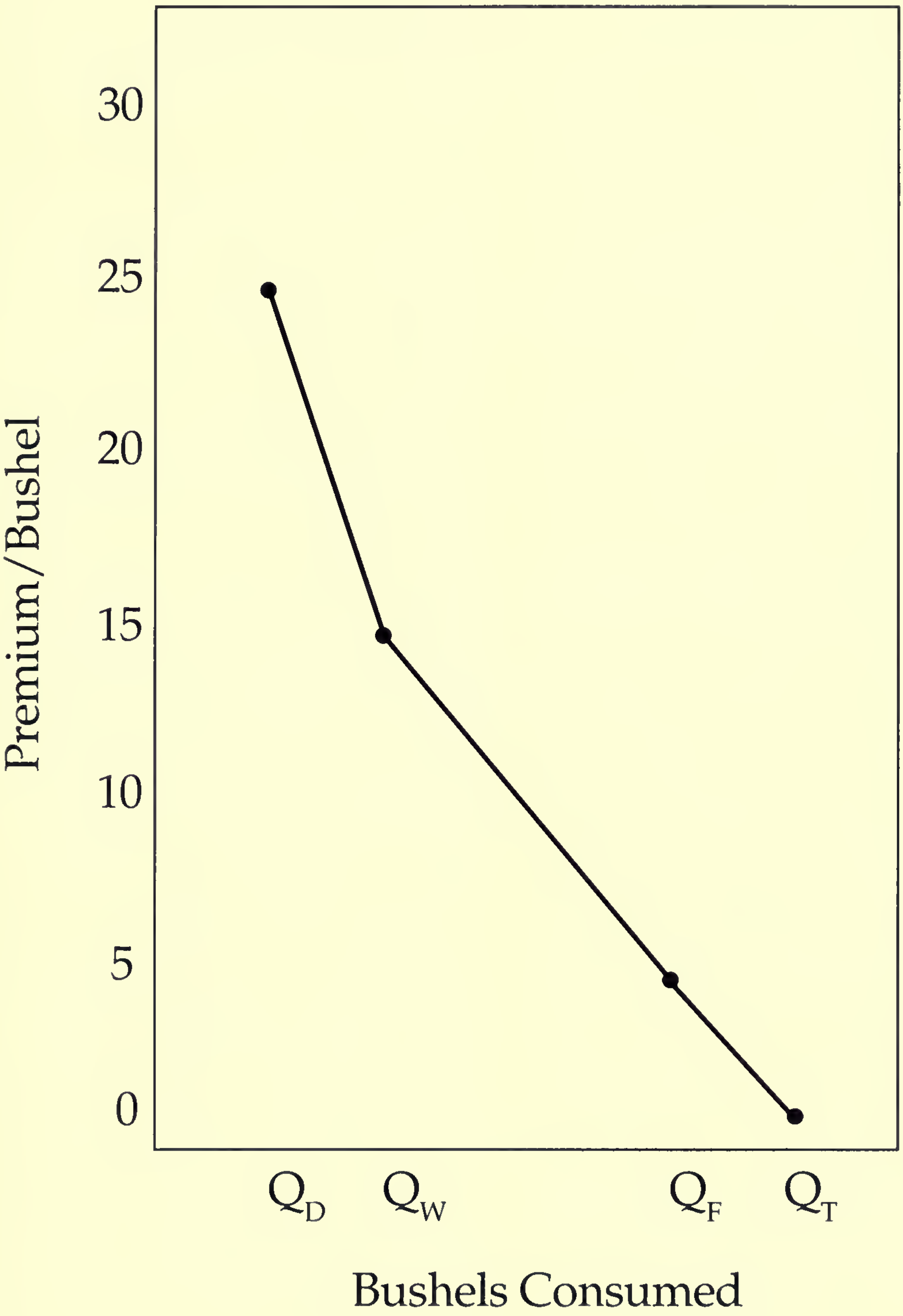
Dry millers, whose product yields are the most sensitive to the effects of drying temperature, would derive more economic benefits from the higher quality than would other industries (Litchfield and Shove 1990). However, since they represent only about 4 percent of the domestic market, the quantity demanded at that premium would be relatively small (Q_D, Figure 1). Wet millers, who manufacture starch and sugar from corn and comprise about 10 to 15 percent of the market, would be willing to pay a premium, but a significantly smaller one than the dry millers. Their benefit from paying a premium to obtain higher quality is based on the ability to achieve higher recovery rates from corn dried at lower temperatures (Weller, Paulsen, and Steinberg 1988). The increased value of less breakage and higher recovery rates would be less for wet millers than the increased value for dry millers, but would still justify the payment of some premiums for the quantity Q_W-Q_D (Figure 1).

Feed manufacturers would derive even less advantage from low-temperature dried corn than the other industries, but would still realize some benefit from reduced breakage during handling. A discount for excess broken corn and foreign material (BCFM) is found throughout the domestic and foreign market channels, indicating a preference for whole, unbroken kernels, and providing a measure of the difference between the market prices for corn and corn screenings. It has been difficult to elicit premiums from exporters for low-breakage corn, but at equal prices, presumably all buyers of corn would prefer the higher quality, low-temperature dried corn, and the demand curve would intersect 100 percent of the market at a zero or near-zero premium (Q_t, Figure 1).

Research Objectives. Several techniques exist for low-temperature drying, such as aeration fans with no heat added, small electric supplemental heaters (five- to seven-degree C temperature rise), and solar collectors. Research has demonstrated a saving in fossil fuels, an increase in energy efficiency, and equal or lower costs of drying from low-temperature technology compared to high-temperature, gas-fired dryers (Sutherland 1981).

Without the offer of premiums, producers have

Figure 1. Theoretical Demand Curve for High-Quality Corn



shifted slowly to low-temperature drying technology, primarily in response to the small advantage of reduced fossil fuel requirements. The adoption of this technology by farmers, however, would presumably be accelerated if price incentives in the market reflected the higher values associated with better quality corn resulting from lower drying temperatures (Hill 1988). Potential buyers of low-temperature dried corn and the marketing intermediaries whose storage and handling facilities will be required for merchandising such corn, need estimates of the potential volume that would be forthcoming at various premiums in order to predict the profitability of offering premiums. Given the current structure of the processing and exporting industries, the market will only pay that premium necessary to elicit the quantity of high-quality corn required to meet the current processing requirements. Two quality characteristics under control of farm technology are of primary interest in this study: resistance to breakage and cleanliness.

Technologies exist on the farm and in most elevators to reduce or remove broken corn and foreign material. The extent to which these technologies are used is a function of the economic incentives and farmers' attitudes. The objectives of this research were to: (1) identify on-farm cleaning, drying, and storing practices and their effect on quality, (2) relate on-farm technology and practices to farm and marketing characteristics, (3) identify farmers' attitudes toward proposals for changing grain grades, with special attention to foreign material, and (4) estimate the shape of the supply curve for low-temperature dried corn.

Research Procedures. Information about the 1986 crop year was collected from questionnaires mailed to a permanent farm panel maintained by the Farm Research Institute (FRI), Urbana, Illinois and to FRI affiliated panels in Iowa and Indiana.

The questionnaire was mailed to 968 farmers in Illinois, 994 farmers in Iowa, and 672 farmers in Indiana. Dr. Charles Sandage of the FRI provided technical advice in designing the questionnaire. The return rates for the survey were 84.9 percent for Illinois, 76.1 percent for Iowa, and 83.5 percent for Indiana; yielding 821, 756, and 561 usable responses respectively. Statistical data on farm and farmer characteristics of each respondent were available from associated data tapes.

In order to study the change in farmer attitudes and practices over time, the results of this study were compared with the results of similar studies done in 1975 and 1981. In addition, data from those farmers who were panel member respondents in both the 1981 and 1986 studies were examined to identify changes in the answers between the two time periods. Information on storage capacities was also compared to similar information from surveys conducted in 1972 and 1977.

Panel members were arrayed according to the total amount of acreage they farmed, using categories similar to those of the 1982 agricultural census. The farm size distribution from the census was used to construct a weighting procedure for expanding the sample data to represent the entire population of farms in the three states. This expansion information is presented in the Appendix. All volume data reported in the remainder of this publication are based on this expanded sample.

One of the objectives of this research was to estimate the shape of a supply curve for high-quality, low-temperature dried corn. Increasingly larger quantities of such corn should be provided in response to increasingly higher prices as more and more farmers transfer to the low-temperature drying technology. Whether the supply and demand curves for high-quality grain would intersect at a positive price cannot be determined because no marketing system is in place for an experimental exploration of price-quality relationships on the demand side.

The aggregate supply response for corn of superior quality was constructed by estimating the quantity of corn marketed by each farmer willing to install a low-temperature dryer at successively higher premiums. Low-temperature dryers consist of bin dryers with either solar or electric heat or no heat added. High-temperature dryers include continuous flow dryers, batch dryers, and bin dryers using gas heat.

The estimates of supply response were derived from the responses of the farm panel to a hypothetical question that related the installation of low-temperature dryers to different price premiums guaranteed in the market. Farmers were asked to indicate the probability that they would install a low-temperature dryer for a premium of one cent, five cents, ten cents, or twenty-five cents per bushel. In some cases the response by farmers would require substitution of a low-temperature dryer for an existing high-temperature dryer. In other cases, farmers not now drying their corn on-farm indicated that they would install a low-temperature dryer if a sufficient premium existed. The quantity of corn dried with low temperature dryers that would be marketed was estimated for each farm. The estimated quantities marketed by each farmer were multiplied by the expansion factor and summed to provide an estimate for each state.

Description of Practices

Storing. The total amount of on-farm storage capacity has increased consistently over time (Table 1). Storage capacity in Illinois and Iowa rose by 22.5 percent and 42.2 percent respectively from 1972 to 1977 (from 987 million to 1,209 million bushels in Illinois and from 1,200 million to 1,707 million bushels in Iowa), primarily due to rapid acreage and production increases in both states and to the profitability of storage during that time period. Total capacity in Iowa and Illinois continued to rise from 1977 to 1986, although at about one-fourth the previous annual rate. Planned expansion in capacity showed continued growth in both states, as well as in Indiana. In every survey period, metal bins dominated on-farm storage, beginning at under 50 percent of total storage in Illinois and Iowa in 1972, and rising by 1986 to 72.9 percent in Illinois, 67.8 percent in Iowa, and 80.0 percent in Indiana. Ear corn cribs were consistently the next most commonly found structure, accounting for about 7 to 10 percent of storage capacity in 1986—a decline from 1972 and 1977 levels. Converted cribs and silos (for both high-moisture and dry shelled corn storage) accounted for much of the remainder. Most of the Illinois and Iowa growth in capacity of bin storage was at the expense of capacity of ear corn crib and converted crib storage. Silo storage for high-moisture and dry shelled corn increased in absolute quantity for Illinois and Iowa but changed little in percentage terms.

Respondents to the 1986 survey were also asked to indicate the amount of on-farm storage they expected to add within the next five years for each type of structure. Projected increases for total storage capacity are relatively small: 6.6 percent for Illinois, 5.1 percent for Iowa, and 7.7 percent for Indiana. These figures reflect a further slowing of production growth as well as an increased reliance on off-farm storage and sales at harvest. Planned increases in metal bin storage over the next five years ranged from 6.7 percent in Iowa to 9.1 percent in Indiana, with far smaller increases in other types of storage facilities. However, some increases (primarily ear corn cribs) may be overstated as respondents were not asked to indicate how much of their storage might be abandoned during the next five years.

Drying. Results of the survey show that 41,694 Illinois farmers, 54,837 Iowa farmers, and 31,811 Indiana farmers (47.9 percent, 55.4 percent, and 41.8 percent of all farmers, respectively) own one or more types of dryers (Table 2). Multiple dryers of the same type were counted as a single unit, because they are often used as a single unit. For example, a farmer may own several storage bins with perforated floors and dryer fans. Counting each bin as a separate dryer would overstate the importance of bin dryers.

Over 15 percent of the farmers in all three states owned more than one type of dryer. In Illinois the percent was 20.3, a decrease of 5.5 percentage points from 1981. Among those farmers with only one type of dryer, the bin with gas heat predominated, accounting for nearly 50 percent or more in each of the three states. Continuous flow and batch types were about equally popular in Illinois. In Iowa and Indiana, the number of batch dryers was nearly double the number of continuous flow dryers (Table 2). A comparison of Illinois data for 1981 and 1986 shows a shift toward continuous flow and gas-fired bin dryers (Table 3). The number of bin dryers using electric heat decreased among farms reporting only one type of dryer. The number of dryers using solar technologies more than doubled between 1981 and 1986, but still accounted for less than 1 percent of all dryers. Most of the farms with multiple types of dryers reported at least one gas-fired bin. The relative popularity of bin dryers versus continuous flow dryers was not significantly changed by including multiple dryer types.

A more accurate comparison of the popularity of the alternative drying methods was obtained by counting the frequency of dryers regardless of the farms on which they were located. For example, a farm with batch, bin, and solar dryers (three different types) would be included three times in the total count of dryers. Multiple units of the same type were counted as one. By this method of counting, the survey indicated that over half of the dryers were gas-fired bin dryers; that use of low-temperature dryers (including solar dryers) ranged from 18.1 percent in Indiana to 25.4 percent in Illinois; and that use of continuous flow dryers ranged from 9.5 percent in Indiana to 11.2 percent in Illinois (Table 4). The frequency of batch dryers ranged from 10.2 percent in Illinois to 18.1 percent in Indiana.

The amount of corn dried on the farm varied among states in proportion to production. However, the highest percentage of on-farm drying was found in Indiana (58 percent of production) and the lowest in Illinois (49 percent of production). In Iowa, 53 percent of corn production was dried on the farm in 1986. Data for 1971 and 1976, available from previous studies, shows a significant increase in the percent of corn dried on-farm in Iowa, Indiana, and Illinois (Table 5).

Cleaning. Corn, as it comes from the combine or farmers' storage bins often contains weed seeds and other nongrain material. If the level of these foreign materials is above 3 percent, the corn is subject to a price discount when it is delivered to the country elevator. In addition, almost any level of foreign material in the grain at the time of storage will increase the probability of storage losses due to molds and insect infestations. It is, therefore, often advantageous to clean the corn on the farm.

Farmers have several options with respect to cleaning in terms of the timing, location, and extent of cleaning. Responses to the survey indicated that 35.9 percent of the farmers in Illinois clean corn or soybeans on the farm. This differed slightly among the three states, with Iowa reporting 37.3 percent and Indiana 39.9 percent (Table 6).

Of the farmers who cleaned their grain, the majority performed cleaning operations prior to putting the grain into storage. In Illinois, 85.9 percent cleaned before storage; 11.9 percent cleaned just prior to delivering the grain for sale at the elevator. Indiana and Iowa reported similar figures.

There are several technologies for cleaning available to farmers. The three principal alternatives identified in the survey were: a screen in the combine auger, a screen section in the loading or unloading auger, and a rotary cleaner used as an independent unit. A variety of other types was mentioned by respondents. These were classified as "other." In Illinois, the most frequently reported cleaning equipment was a screen section in the loading and unloading auger. Of the farmers who reported cleaning grain on the farm, 38.5 percent used a screen section in the loading auger, 29.7 percent used a screen in the combine auger, and 21.8 percent used a rotary cleaner. In Iowa, the most frequently reported method for cleaning was the rotary cleaner (37.3 percent), followed by a screen section in the loading and unloading auger (27.8 percent), and by a screen in the combine auger (25.7 percent). In Indiana, the responses were nearly evenly divided among the three cleaning devices (Table 6).

Farmers have several alternatives for disposing of the screenings which they remove during cleaning. The most frequent use of the screenings was as feed for livestock on the farms where cleaning took place. In Illinois, 60.6 percent of farmers reported feeding the screenings, compared to only 9.1 percent who found a market and sold screenings to feeders or other buyers. Iowa and Indiana reported even higher proportions fed to livestock. Surprisingly, as many as 30.3 percent of the farmers reported disposing of the screenings by other means. The explanation most frequently given was that the screenings were discarded—presumably burned or taken to a land fill. No other economic uses were identified.

Current grade standards and elevator discounting practices generally pay farmers full price for any corn with no more than 3 percent foreign material when it is delivered for sale. Farmers were asked whether they adjusted their combine to deliver the lowest possible amount of foreign material or if they targeted their cleaning to deliver as much foreign material as possible without being discounted. The latter alternative would, of course, increase farmers' income since they would be able to sell screenings (weed seeds and broken corn) for the full price of corn. In Illinois, 12.4 percent of the respondents reported that they adjusted the combine to deliver the maximum amount of foreign material allowed by the market. In contrast, over 86 percent of the farmers in all three states reported that they adjusted their combine to deliver the lowest possible amount of foreign material (Table 6). In the interest of delivering clean grain, these farmers were sacrificing the opportunity to sell extraneous material at corn prices.

This same issue was also addressed by a question asking farmers if they set their combine differently for grain to be stored on the farm than they did for grain to be delivered directly to the elevator. Only 4.6 percent of the producers in Illinois, 4.5 percent in Indiana, and 3.8 percent in Iowa reported using a different combine setting when storing in their own facility than when selling directly to the elevator.

On farms storing a higher percent of grain and soybeans on the farm, there was a tendency to do more on-farm cleaning. The percent of farmers using all types of cleaners generally increased as the percent of corn and soybeans stored on the farm increased, indicating some economies of scale present in the use of grain cleaners (Table 7). There were a few exceptions to the on-farm cleaning trends, especially in Iowa, where more than 50 percent of corn and soybeans were stored on-farm.

The type of cleaner used and the setting of the combine to control percent of BCFM did not appear to be related to the type of farm or to the frequency or percent of sales that were discounted for foreign material at the elevator when the grain was sold. Farmers' decisions about cleaning appeared to be determined primarily by storage practices and use requirements on the farm and by general attitude toward management practices.

Average Quality Pricing. To determine the extent of farmers' understanding of the role of grades and standards in generating price differentials in the markets, they were asked if they would like to eliminate all discounts and premiums for quality except for moisture, and receive one average price for grain regardless of quality. Since few grain buyers pay premiums for superior quality, a response to eliminate discounts could be interpreted by farmers as a way to increase their net price. Market adjustments in base prices would negate this advantage, but farmers have often argued against grade changes because it would increase their discounts and lower their income. In the aggregate, failure to differentiate price according to quality differences (i.e., eliminating discounts) would reduce average price and eliminate all incentives for quality improvement. Thus the question tested producers' knowledge of the principle of pricing according to value, as well as their ability to differentiate between the effect of the actions of individual farmers and the aggregate effect of those actions upon overall quality and value. Surprisingly, over 61.4 percent of Illinois farmers said they did not favor the elimination of discounts and premiums for quality. The percent was slightly higher for Iowa and slightly lower for Indiana (Table 8). Differences in responses were observed for factors of respondents' age and education. Older farmers (over 55) and respondents with a maximum of 12 years of education were more inclined to eliminate discounts and premiums than younger farmers. For example, 70.3 percent of Illinois farmers 55 or younger did not want discounts and premiums eliminated. Similarly, farmers with over 12 years of education strongly supported discounts and premiums that reflected differences in quality.

Explanation of Dryer Ownership

The type of dryer owned by farmers was found to be related to several farm and farmer characteristics.

Characteristics of Farms and Farmers.

Volume Dried. Previous studies have shown that the ownership of a grain dryer is generally dependent upon the farmer having an adequate volume of grain to justify the initial investment and to take advantage of economies of scale (Kau and Hill 1973). This is especially true for continuous flow dryers which require a large initial investment; also, they can only be used for drying, unlike bin dryers which can also be used for providing storage. The majority of farmers reporting the use of continuous flow dryers dried over 10,000 bushels (Table 9). In Illinois, 20.1 percent of farmers with continuous flow dryers dried over 50,000 bushels. In Indiana, 40.5 percent of farmers with continuous flow dryers dried over 50,000 bushels. Iowa was more heavily weighted toward the 10,000- to 25,000-bushel range. Fewer than 20 percent of the continuous flow dryers were found on farms drying fewer than 10,000 bushels of corn in 1986, except in Illinois. A few farmers with continuous flow dryers who did not dry corn in 1986 distorted the pattern in Illinois and Iowa. As will be discussed later, this distortion does not alter the relationship between economies of size and continuous flow dryers.

Farmers owning batch dryers generally dry smaller amounts of corn than farmers owning continuous flow dryers. In all three states (with a slight exception in Indiana) the majority of batch dryers was found among farmers who dried in the 10,000- to 50,000-bushel range. High- and low-temperature bin dryers tend to be used by farmers with smaller volumes of corn, although about one-fourth of bin dryers were found on larger farms.

These results are similar to those obtained in 1981 for Illinois (the only state surveyed at that time). The only significant change in 1986 was a decrease in the percent of low-temperature dryers found in the extremely low-volume size category, namely those drying fewer than 5,000 bushels.

Acreage. Acreage is another measure of size and is therefore related to type of dryer. Continuous flow dryers were concentrated on farms of 500 acres or more in all the states (Tables 10–12). High- and low-temperature bin dryers, in contrast, were less frequently found in the highest acreage category, but were concentrated on smaller farms, primarily 200-499 acres. Fewer than 10 percent of the continuous flow or batch dryers were found on farms with less than 100 acres of cropland.

Age. The majority of farmers using dryers were less than 55 years of age. In Illinois, 64.9 percent of farmers without dryers were over 55 years of age, compared with 63.8 percent in Indiana and 49.1 percent in Iowa (Tables 10–12). More than 55 percent of Illinois farmers reporting high-temperature bin dryers were 55 years or younger; the relationship was reversed for Indiana and Iowa. Farmers in all states reporting use of continuous flow and batch dryers tended to be younger than those reporting bin dryers.

Education. Educational levels differed among farmers owning different types of dryers, but the differences and the variability among states and dryer types do not provide a consistent pattern or a basis for explanation. There was a tendency for farmers operating the more complex systems (low-temperature bin and continuous flow dryers) to have more years of education. In all three states, farmers without dryers averaged fewer years of education than those with dryers.

Farm Type. A farm was classified as a hog farm if over 100 market hogs were sold per year. This criterion was based on previous research indicating a "threshold" at this size (Hill 1970). A grain farm was one for which more than 50 percent of gross income came from grain. Farms that did not meet either of these criteria were classified as "other." Farm type influenced the use of dryers, as a result of on-farm drying and storage of corn for feeding hogs. Grain farms with little or no livestock more often sold wet corn at harvest. Only 4.9 percent of Illinois (Table 10) and 8.7 percent of Indiana hog farmers had no dryer (Table 11). In Iowa, 22.6 percent of the hog farmers had no dryer, in contrast to 42.1 percent of the grain farmers (Table 12). Hog operations generally require on-farm shelled corn dried to safe storage levels. Low-temperature dryers were also popular with hog farmers, 19 to 44 percent of whom, depending on the state, owned this dryer type. Grain farmers favored high-temperature dryers, including continuous flow, batch, and high-temperature bin dryers. With the exception of Illinois, low-temperature bins were relatively unpopular on grain farms.

Factors Influencing Volume Dried. In order to identify which factors were important in determining the amount of corn dried, a multiple regression model was constructed with bushels of corn dried divided by total corn production as the dependent variable. The dependent variable was put in percentage terms in order to avoid the problem of multicollinearity between the volume produced and the volume dried. On many farms these two variables are identical because all corn harvested must be dried. Five independent variables were chosen: (1) the value of farm products sold, (2) the percent of corn production stored on the farm, (3) the farm operator's age, (4) the farm operator's years of education, and (5) the farm type, based on whether the farm produced primarily grain or hogs. A farm was designated as a grain type if the majority of gross income was generated from grain sales; it was entered as a 0–1 dummy variable. A farm was designated as a hog farm if it produced 100 or more hogs; it was entered as a 0–1 dummy variable. Farms not falling in one of these two categories were classified as "other."

For the regression using data from Illinois farms, the adjusted R^2 of .43 indicates that slightly under half of the variability in the volume of corn dried was accounted for by changes in the independent variables. The t-values show that the coefficients of nearly all independent variables were significantly different from zero at the .01 level; all were significant at the .10 level (Table 13).

The adjusted R^2 value using Iowa data was .24. Again, all independent variables except age had significant coefficients at the .01 level. While the adjusted R^2 value was quite low, the significant coefficients suggest that these variables are important influences on the percent of corn dried on-farm.

The adjusted R^2 value for Indiana data was .44 and all variables were significant at the .01 level. The coefficients for farm type were approximately one-half the magnitude estimated for Illinois and Iowa. This suggests that farm types other than hog and grain farms, as defined in this study, were also using dryers. In Indiana, a higher percent of dryers was reported by "other" farm types than was reported in either Iowa or Illinois (Tables 10–12).

The signs for the coefficients for each of the variables were the same for all three states except for age and education, and were consistent with theoretical relationships. The value of products sold (a measure of size of enterprise) was negatively correlated with the percent of corn dried on farm—the larger farms transferred the drying function to the market. On-farm storage generally requires on-farm drying and the coefficient was positive. Hog and grain farms were more likely to have dryers than those where corn production and use of shelled corn was of less importance.

Age and education were the only variables to have conflicting results—negative for Illinois and positive for Indiana and Iowa. In the case of Iowa, however, the coefficient for age was not significantly different from zero (Table 13).

Supply Response

Each farmer was asked to indicate the probability of purchasing a low-temperature drying system if guaranteed a premium of one cent, five cents, ten cents, or twenty-five cents per bushel. The probability of purchase at each premium is shown in Table 14.

Estimated Quantities at Selected Premiums. The aggregate supply of low-temperature dried corn was estimated by summing the volume of corn that would be dried at each level of price premium by those farmers reporting a probability greater than 60 percent that they would install a low-temperature drying system in response to the designated premium.

The calculations required the following assumptions:

1. For farmers owning high-temperature dryers, the volume of corn dried with a newly installed low-temperature dryer would be equal to that volume dried on the farm in 1986; that is, the new dryer would be a complete substitution for the existing dryer. If the purchase of a new drying system is economically justified, then the quality premiums would cover operating costs for the entire volume dried once the investment has been made.
2. The percent of production dried by farmers who had no grain dryer in 1986, but who would purchase a low-temperature dryer, is equal to that of the average farmer with the same farm size and type who owned an on-farm dryer in 1986.
3. All corn dried with low-temperature dryers would be delivered to the market. If farmers require a market premium for high-quality corn in order to justify the purchase of a low-temperature dryer, they must deliver that corn to the market to realize the premium and compensate for the disincentive of changing dryers.
4. Only those predicting a 61–80 percent or 81–100 percent probability will actually purchase a dryer.

Calculations based on the preceding assumptions show that in Illinois a ten-cent premium per bushel would generate an additional 73.6 million bushels of corn dried with low-temperature dryers. A twenty-five-cent premium per bushel would result in an additional 301.0 million bushels. One-cent and five-cent premiums would elicit no additional volume from Illinois farmers, although some farmers already using low-temperature dryers responded that they would purchase a new dryer at these premiums (Table 14). In contrast, a one-cent premium in Iowa would generate an additional 6.4 million bushels of low-temperature dried corn and a twenty-five-cent premium would provide another 330.1 million bushels to the market. In Indiana, the amounts offered would range from 1.4 million for a one-cent premium to 202.6 million bushels for a twenty-five-cent premium (Table 15).

Ordered-Response Model. Farmers' responses to potential premiums are conditioned by farm and farmer characteristics. The simultaneous effects of these other variables were incorporated using a logit model with probability of purchasing a low-temperature dryer as the dependent variable. The survey question concerning farmers' probability of purchasing a low-temperature dryer allowed the respondent a choice of six response categories: 0, 1–20, 21–40, etc. The zero category included respondents who were not interested in purchasing a dryer at the specified premium. Category One included answers indicating a probability of buying a low-temperature dryer between 1 and 20 percent; Category Two, between 21 and 40 percent; etc. This grouping provided six possible values for the dependent variable (Table 14). Given the structure of the dependent variable (the probability of purchasing a low-temperature dryer), the model selected for estimation was an ordered-response model. In general (Maddala 1983), the probability associated with each category of the dependent variable is described as $P_m = F(b'x)$, $P_m = F(b'x + a') - F(b'x)$, . . . , where $_m$ denotes a category. Estimates of those values were obtained using the maximum likelihood procedure. The iterative procedure applied in this study was the Davidson-Fletcher-Powell procedure. The procedure took twelve to thirteen iterations to converge, which was slightly more than the number of required iterations reported by Maddala (1983), who used the Newton-Raphson procedure.

Estimation results are presented in Table 16. The specified models fit the sample data well, as suggested by high chi-square values, although the fit was better for Illinois and Indiana data than for Iowa data. This difference can be attributed to differences in the degree of farm specialization in the three states, especially to the importance of livestock production on many Iowa farms.

Estimation results of the three models also showed that some factors significantly influenced the decision to purchase a low-temperature dryer in all three states considered in this study. The variables of age and amount of premium had coefficients that were consistently significantly different from zero in all three states, with age negatively influencing the purchase decision and premiums having a positive effect. The sizes of the age and premium coefficients were frequently similar, particularly in the Indiana and Illinois models. The coefficient corresponding to the gross income variable (x_1 = 1 if value of products sold was greater than \$200,000) was significantly different from zero only in the case of the Illinois model, and may suggest a greater dependence of Illinois farms on income from grain sales than of farms in Indiana and Iowa. The coefficient representing the farm type variable (the variable equals one if a grain farm, zero otherwise) was significantly different from zero in the case of Illinois and Indiana models.

Farmer Attitudes Toward Grade Changes

Grade Factors — Corn. Current grades and standards for corn and soybeans have several limitations in their provision of relevant information to processors and consumers. Some factors in the current grades measure characteristics that are of little economic relevance. On the other hand, many properties of corn and soybeans that are of interest to various processors and consumers are not included in the grades (Hill 1988). Several proposals for changing the grades have been made by the USDA and Congress (Gordon 1990). An issue currently being debated is the separation of the grade factor "broken corn and foreign material" (BCFM) into two factors—"broken corn" and "foreign material." Under a temporary program, the Federal Grain Inspection Service (FGIS) is recording the percent of broken corn and the percent of foreign material in the information section of the grade certificate. It has been proposed that this should be made a permanent change in grades, substituting the two factors for the current BCFM factor. However, this change will not be made without the support of the most important interest group in the grain trade—the producers.

Despite the support of many farm organizations for several revisions in the current grades for corn, the 1986 survey results showed no strong support for change from farmers. The majority reported that they favored keeping all the current grade factors, although some farmers did favor changes in factor limits and in the definition of certain factors (Table 17).

BCFM. Support for change was greatest for broken corn and foreign material (BCFM). Even so, less than half the respondents favored changing or removing this factor: 31.4 percent in Illinois, 39.5 percent in Iowa, and 42.1 percent in Indiana. The BCFM factor also received the most unsolicited comments from farmers in the survey.

One of the reasons often given by farmers for wanting to change the BCFM factor was that the current definition does not differentiate between foreign material and broken corn. Broken pieces of corn differ from foreign material both in chemical content and physical properties. To most consumers, the broken pieces of corn, which can be separated by screening have almost the same economic value as No. 3 corn, especially when it is used for livestock feed. Many farmers made the comment "Broken corn is still corn." In their opinion, therefore, it is not accurate or fair to assign the same discount for broken corn as for foreign material.

Other concerns about BCFM expressed by farmers were the increase of foreign complaints and the loss of foreign markets due to quality problems. The current definition of BCFM and the factor limits in corn grades No. 2 and No. 3 encourage farmers and grain handlers to deliver corn containing the maximum percent of BCFM allowed in the grade. Farmers' responses reflected their belief that most grain leaves the farm in good condition, containing little foreign material. Several commented that blending to meet the maximum allowable BCFM reduces the value of their product and erodes the foreign markets on which they rely. Many respondents wanted to make the standards stricter to eliminate blending. A typical comment from farmers was "Pay according to quality. Don't blend others' grain with mine to get average grade."

Other comments on this factor reflect concern that no premium is paid for levels of BCFM below the grade limit to offset the discount given for levels above the limit. One farmer commented, "My corn and beans run less than 0.8 percent FM but I get no more than somebody with FM at 3 percent." Despite comments such as this, 68.6 percent of Illinois farmers voted to keep the current standards for BCFM. Iowa and Indiana response rates were similar.

Total and Heat Damage. At least three-quarters of the farmers in each state wanted to keep the grade factors for heat damage and total damage in their current form (Table 17). In no state did more than 21.3 percent of farmers favor changing, or more than 3.6 percent favor removing, the heat damage factor. Farmers in Iowa and Indiana were slightly more critical of total damage than of heat damage; Illinois farmers were slightly less critical.

Most of the comments suggested stricter standards for total damage in order to provide higher quality grain for export. One Illinois farmer commented, "[We] need to tighten up damage grades and foreign material standards to assure good quality grain going into export channels." Others commented that "there must be a way to protect against spoiled grain," and that "a premium should be paid if grain has no damage." There was also strong sentiment for reducing the limits on the heat damage factor because heat damage is easily controlled.

Test Weight. Relatively few respondents would change the test weight factor. No more than 12.9 percent of farmers in any state favored changing or removing this factor (Table 17). One of the reasons given by those farmers who did want to change the test weight factor was that they felt they were already being penalized for lightweight grain since bushel measurement is based upon weight.[1] Some farmers also commented that although they had been discounted for test weight below 54 pounds per bushel, they never received a premium for corn weighing over 54 pounds per bushel. Almost 90 percent of the farmers chose to keep the test weight factor in the corn grades. No comments were offered to explain their support of the status quo for a factor of so little economic significance in determining value (Hill and Jensen 1977; Hall and Hill 1973).

Grade Factors — Soybeans. Farmer attitudes toward changing soybean grades were similar to those for corn. The majority of farmers would like to keep most of the grade factors in their present form. Between 84.5 percent (Iowa) and 89.4 percent (Illinois) of farmers wanted to keep test weight as it is currently defined in the grades (Table 18). Test weight, foreign material, heat damage, and total damage in their current form received a vote of confidence from over 73 percent of the farmers in each state.

Splits. The greatest support for change was in the factor of splits: over 45 percent of Indiana and Iowa farmers wanted to change or remove it. In Illinois, over one-third of the respondents wanted the factor removed from soybean grades completely, and another 22.5 percent wanted the factor changed. In the comment section of the questionnaire, most farmers indicated that splits are unavoidable when harvesting at low moisture levels and they objected to discounts on factors over which they had little control. This raises again the question of what is the purpose of grades (Hill 1990a): to describe characteristics on which buyers estimate value or to reward producers according to effort?

FM and Damage. Support for keeping foreign material, total damage, and heat damage in the soybean grades differed among the three states. Over 26 percent of farmers in Illinois were in favor of changing or removing heat damage, contrasted with 15.3 percent in Iowa and Indiana (Table 18). For total damage and foreign material, a slightly higher percent of farmers in Iowa than in Illinois or Indiana registered dissatisfaction. As with corn, most complaints about foreign material referred to elevators being allowed to blend foreign material with clean soybeans to meet the grade limit.[2] Several farmers also objected to the fact that current grades do not differentiate between broken beans and foreign material. However, because FM problems in soybeans are not as serious as in corn, fewer farmers were in favor of changing the FM factor in the soybean grades.

Relationship Between Discounts and Attitudes.

Corn. Respondents were asked to indicate what percent of their 1986 sales of corn were discounted for foreign material. Choices on the questionnaire were tested by ranges. The majority of farmers in all three states reported no discounts for foreign material on any of their 1986 sales. Most of those who reported discounts indicated that fewer than 5 percent of their sales had received any discount (Table 19). The percent of sales discounted as reported by Indiana farmers was higher—no explanation was found for the difference.

Despite many comments from respondents about the unfairness of the BCFM discount, the majority wanted to keep the factor in its current form (Table 17). A possible explanation for this attitude might be that relatively few farmers received discounts for foreign material in corn, and therefore, did not want to support a revision that might increase discounts.

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[1] This is, in fact, a misunderstanding of the test weight factor. Test weight is a measure of density and is unrelated to the number of pounds established as defining a bushel quantity.

[2] Blending foreign material with soybeans is now prohibited by law.

If farmers base their opinions about keeping or changing grades on the economic consequences of current grades relative to alternative changes, there should be a relationship between frequency of discounts and preference for changing grades. In order to examine this relationship, the chi-square statistic was used to test the hypothesis that farmers' attitudes toward changing the BCFM factor were independent of the percentage of sales discounted. Farmers in the three states who received discounts on less than 5 percent of their grain were classified as Group l; farmers who reported discounts on 5 percent or more of their sales were categorized as Group 2. The attitudes of these two groups of farmers toward changing the BCFM factor were then compared using the chi-square test for samples from the same population. The number of farmers who chose to keep, change, and remove the BCFM factor in each group is shown in Table 20.

The H_0 (null) hypothesis is that Group 1 held the same attitude toward change as Group 2. The H_1 (alternative) hypothesis is that they did not have the same attitude.

The calculated chi-square value of 7.373 is greater than 5.99—the value that corresponds to the probability of .05 in the chi-square tables with two degrees of freedom. Therefore, the hypothesis that the attitudes were independent of the frequency of discounts was rejected. The attitudes of farmers who received minimal discounts (discounts on fewer than 5 percent of their sales) were significantly different toward changes in the factor of BCFM than the attitudes of farmers who were discounted on 5 percent or more of their sales. A higher percentage of farmers receiving minimal discounts wanted to keep current grade standards for BCFM. Farmers receiving discounts on 5 percent or more of their sales opted for changing or removing the BCFM factor—the source of their discounts.

Soybeans. The responses on foreign material discounts in soybeans were similar to those for corn. Most farmers were discounted on fewer than 5 percent of their sales (Table 21). As with corn, discounts were encountered more frequently by farmers in Indiana than in the other states. No data were available from the survey to determine if the differences among states were related to different levels of weed seeds and broken grains or were the result of more severe grading.

The relationship between soybean discounts and farmers' attitudes toward foreign material in soybeans was tested, using the same procedure as for discounts on corn sales (Table 22).

The calculated chi-square value with two degrees of freedom was 9.278, which rejects the hypothesis of independence at the .05 probability level. The differences for soybeans are even larger than for corn, allowing rejection of the hypothesis at the .01 level—$9.278 > 9.21$. Farmers who frequently received discounts on more than 5 percent of their soybean sales favored change more often than farmers who received few or no discounts.

New Measures of Quality. As discussed earlier, some characteristics reflecting quality and value are not included in the current grades for corn and soybeans. The addition of new factors to grades or standards will require farmer support. Several characteristics of corn and soybeans were listed in the survey, and farmers were asked to rank the importance of each as a potential measure of value.

A majority of farmers were in favor of additional grade factors for both corn and soybeans, ranking most factors as "very important" or "of some importance" for including in official grades. The factors that were most frequently ranked high were protein, starch, mold (as separate from damage), and storage life for corn; and protein, oil, and mold (as separate from damage), for soybeans (Tables 23 and 24).

Mold was ranked highest among the proposed additional factors for both corn and soybeans. Mold in corn was considered very important or of some importance by 96.0 percent of the farmers in Illinois, 90.0 percent in Iowa, and 83.8 percent in Indiana. Mold damage was ranked as important for inclusion in future soybean grades or standards for soybeans by 90.1 percent of Illinois farmers, 88.7 percent of Iowa farmers, and 84.9 percent of Indiana farmers. Over half of the respondents thought mold was very important as a grade factor for both corn and soybeans. Farmers' comments identified mold damage as critical because it "affected the feed and food value" and "affected the quality of exports and storability."

Protein content is an economically important chemical property in both corn and soybeans and the majority of farmers in all three states ranked this property as very important or of some importance for including in grades. In Illinois, 86.2 percent of the respondents checked important or very important for corn grades. In Iowa, the response was 81.6 percent; in Indiana 73.3 percent. Nearly the same percentage of farmers judged protein to be very important or of some importance for soybeans.

Oil content followed protein content in the percentage of farmers supporting it as a new factor for soybeans: 85.3 percent of Illinois farmers, 85.9 percent of Iowa farmers, and 80.7 percent of Indiana farmers considered it important or very important. However, fewer than 70 percent of the farmers in the three states considered this characteristic important for corn. Soybean oil is a major product in the processing industry while corn oil is a relatively minor product. Farmers' opinions of relative importance were consistent with research and industry practices.

Starch, another indicator of nutritional and processing value of corn, was considered important or very important by 74.0 percent of Illinois farmers, 68.8 percent of Iowa farmers, and 67.8 percent of Indiana farmers. However, fewer than half of the farmers in the three states considered starch important or very important for soybeans.

The respondents also considered storage life to be important in determining value of corn and soybeans and therefore a candidate for a future grade factor. Since there is no direct measure of this characteristic, the importance attached to it suggests support for developing a quantitative measure. The length of time grain can be stored without affecting quality is crucial at each point in the market channel because a large part of the corn and soybean crops are exported or stored. Of the farmers responding, 64.4 percent in Illinois, 74.0 percent in Iowa, and 71.7 percent in Indiana considered storage life important or very important for corn. Comparable figures for soybeans were 57.4 percent of farmers in Illinois, 71.7 percent in Iowa, and 71.6 percent in Indiana. Compared with the other two states, fewer Illinois farmers judged storage life to be a very important measure of quality.

Stress cracks and brittleness are two alternative measures of the breakage susceptibility of corn. These characteristics had the least support for inclusion as grade factors. For example, only 8.5 percent of Illinois farmers ranked stress cracks as very important, although over 50 percent said stress cracks were of some importance. The remarks farmers made about these factors were similar to those for broken corn. Farmers commented that broken corn and beans were "still corn and beans."

In summary, a majority of farmers considered most of the proposed factors important for including in future grades and standards. They hoped that the additional factors would improve the efficiency of the corn and soybean marketing system and help determine value in domestic and foreign markets. At the same time, they commented that new factors must be accompanied by appropriate price incentives. A typical comment was that "built into these new factors must be opportunities for offering premiums and other incentives for high-quality grain production." On the other hand, some farmers were concerned that some of these quality attributes were outside their control, and additional factors would only mean additional discounts if premiums were not established. Several farmers recognized that sampling, testing, and segregation of different qualities could add to the cost of marketing.

The issue of premiums and discounts elicited comments not only regarding future grade factors, but also for current grades. Many remarks illustrated that farmers were dissatisfied with the current discount and premium system. However, when they were asked whether they would like to eliminate all discounts and premiums and just receive one average price for grains, 61.4 percent of Illinois farmers, 68.3 percent of Iowa farmers, and 55.8 percent of Indiana farmers responded "no" (Table 8).

Most farmers believed that a discount is necessary to differentiate the economic value of different levels of grain quality in order to stimulate improvement in grain quality. Nevertheless, they were not satisfied with the fact that there were discounts but no premiums. They believed that discounts for poor quality should be accompanied by premiums for superior quality as an incentive for improvement. One Illinois farmer commented, "I feel I speak for a lot of farmers when I say I take notable pride in doing the best job I can in harvesting and storing our grain to keep it as high quality as possible. However, I feel that there is little incentive given farmers to go to the trouble of keeping grain in good condition. We are *never* given a premium for good grain, but *certainly* discounted for poorer quality grain. Positive incentives are *needed*!"

Another Illinois farmer commented, when evaluating the importance of additional grade factors, "If a buyer finds any of these grade standard [factors] important enough to pay a premium, then I would be glad to make changes to accommodate the buyers."

Proposals for Reducing Foreign Material. Since foreign material and broken grains have received so much attention in foreign complaints and legislative action, the surveys asked farmers for suggested ways of reducing foreign material in both corn and soybeans. The three most popular means were: (1) enacting legislative prohibitions against blending and adding FM to clean grain, (2) introducing incentives to lower FM content, and (3) separating BC from FM (Table 25).

A majority of farmers favored legislative prohibitions against blending FM with grain. From 52 to 62 percent of farmers in the three states considered this an effective measure for reducing FM. In addition (or as an alternative) about half of the farmers in these three states wanted to introduce premiums or subsidies for FM content below contract grade to motivate farmers to deliver cleaner corn and soybeans. Changing the factor definitions in the grades to separate the broken corn from foreign material in current grades and treat BC differently from FM was supported by 32.2 percent of Illinois farmers, 33.9 percent of Iowa farmers, and 30.1 percent of Indiana farmers.

Farmers desiring the separation of broken corn and foreign material were asked to indicate the percent of FM they would like to allow before the market applied a discount. Remarkably, the limit suggested by many farmers was 0 percent: 31.7 percent of Illinois farmers, 37.7 percent of Iowa farmers, and 41.4 percent of Indiana farmers suggested that any foreign material in the grain should be discounted (Table 26). This implies treating FM as dockage, which has been recommended in several proposals for corn and soybeans and is currently being used in wheat. Another 17 to 21 percent of farmers, depending on the state, who did not choose to start discounts at 0 percent, suggested starting discounts at levels below the current limit for BCFM in No. 2 corn. Among the remaining farmers who chose to separate BC from FM, the 2, 3, and 5 percent limits for discounts received the most votes. These limits are familiar numbers for farmers since they correspond to the current limits for BCFM for No.1, No.2, and No.3 grades respectively. In conclusion, farmers demonstrated strong support for tightening the current grade limits for FM by reducing the maximum allowable FM before receiving a discount.

Based on the question dealing only with how to reduce the level of FM, one can conclude that the majority of farmers in the three states were not satisfied with the current standards for BCFM. None of the respondents in Illinois and Iowa wanted to leave the current system as it is. They indicated that FM levels in corn and soybeans could not be reduced under the current system. Even in Indiana, only 21.8 percent of farmers favored keeping the current system for BCFM for both corn and soybeans if the objective is to reduce FM levels in the market channel (Table 25).

These results are not consistent with the high numbers of farmers choosing to keep the current BCFM factor for corn and FM factor for soybeans when the question was asked in the context of the structure of the current grades (Tables 17 and 18). A possible explanation for the discrepancy may be that farmers' short-run attitudes toward the current system for BCFM differ from their long-run attitudes. In the short-run, more farmers might want to keep the current system when they consider their short-run economic welfare, as for example, in the case of discounts. As discussed earlier, most farmers in the three states were discounted little, if at all, for BCFM. Therefore, farmers would feel less urgency to change the grade standard for BCFM, since the current system did not work against their economic interest.

However, the short-run conclusion of most farmers to keep the BCFM factor did not necessarily mean that farmers were satisfied with the current system in the context of long-run incentives and equity. Many farmers realized that the current BCFM standard would eventually affect their economic welfare, especially if it resulted in foreign complaints and loss of foreign markets. Subsequently, when farmers were asked to identify methods for reducing FM in corn and soybeans, several farmers changed their response from "keep it unchanged" and selected one of the options for change.

Changes in Attitudes over Time — Corn Grades

Current Factors. In order to investigate changes in farmers' attitudes over time, the results of the 1986 survey were compared with similar data collected by FRI from Illinois and Iowa farmers in 1975 and from Illinois farmers in 1981 (Hill and Vercimak 1979; Hill and Rehtmeyer 1982; Pepper and Hill 1977). Indiana farmers were not included in the earlier surveys. The composition of the Illinois and Iowa panels remained fairly constant over the three surveys.

The number of Illinois farmers desiring changes in the grades increased between 1975 and 1981 for all factors, but surprisingly, the trend stopped or reversed in 1986 (Table 27). In the 1986 survey, fewer Illinois and Iowa farmers chose to change or remove test weight from corn standards compared to 1975. With heat damage, the percent of Illinois farmers who favored change increased but fewer Iowa farmers wanted a change. The percentage of farmers wanting to change the total damage factor in 1986 was almost the same as in 1975 for both states, although Illinois data showed a major increase in 1981. The comparison for the BCFM factor showed very similar support in 1975 and 1986.

New Factors. The percent of farmers who ranked the suggested grade factors as important or very important decreased between 1975 and 1986: in most cases the data for 1981 prevented the determination of a trend over the longer time period (Table 28). For example, 93.0 percent of Illinois farmers considered protein important in 1975, yet only 86.2 percent of farmers still thought it was important in 1986. In this case the lowest support (73.4 percent) was in 1981. In the case of mold damage, there was little change in the rankings by Illinois farmers between 1975 and 1986, but there was a small decrease in Iowa responses.

Stress cracks as a measure of quality received the least support of all factors in all years, and the percent of farmers ranking this measure of quality as important decreased in 1981 and 1986 relative to 1975.

The shift in attitudes over time away from support for changes in grades was difficult to explain, especially when farm magazines, congressmen, and farm organizations had conducted a ten-year campaign to provide an understanding of and support for several grade changes to improve accuracy and equity in measuring quality. One hypothesis offered in explanation of the lower percent of farmers supporting grade changes was that the make-up of the panel had changed over time. Since many of the same farmers were in the panel both years, an analysis was made to determine how many farmers supporting changes in grades in 1981 had reversed their position in the 1986 survey.

Of the Illinois farmers who completed the 1981 questionnaire, 396 also answered the same question about grade changes on the 1986 questionnaire. These respondents were separated into three groups: those who gave the same answer in both years, those who changed their answer to less favorable toward change, and those who changed their answer to more favorable toward change (Table 29).

It appears from these comparisons that much of the 1981-1986 shift in support for changes in grades could be attributed to a reversal of the position of farmers who responded in both years. For the test weight factor, 28.2 percent changed their response to a less favorable attitude toward change (i.e., from "change" to "keep" or from "remove" to "change"). Only 13.1 percent altered their responses to more strongly support change. The net effect was a 15.1 percent shift toward opposition to change. Similar results were found for each current factor in the survey. There was a net loss of support for change between 1981 and 1986 when the answer of each individual farmer in 1981 was matched with the answer of that same farmer in 1986. The same pattern is present for attitudes toward introduction of mold as a grade factor. In contrast, the use of protein and starch for measuring quality of corn gained support over time from the group of farmers responding in both years. There was also increased support for these two characteristics from all farmers surveyed in Illinois.

The data and analysis are not sufficiently detailed to permit an explanation of the attitudinal shift over the period of the study. However, the data indicate that over the past seven years a significant number of farmers reversed their position toward changes in grades and most of these reversals were in the direction of withdrawing support.

An additional test to determine if the more permanent members of the panel differed from the new additions was conducted by dividing the responses into two groups. One group consisted of the 396 farmers who were involved in both the 1981 and 1986 surveys. The other group consisted of 426 farmers who were in the 1986 study only. According to the analysis, there is no significant difference at the .05 level of probability between the attitudes of the two groups (Table 30).

Farmers were generally conservative about changes in grade standards, particularly older farmers. If we classify the farmers who were involved in both the 1981 and the 1986 survey as Group A and those involved in just the 1986 survey as Group B, we find that farmers in Group A were much older than those in Group B. The mean age was 55.4 years for Group A and 48.3 years for Group B. According to the study, the older farmers (Group A) were more inclined to change their attitude to "unfavorable" than to "favorable" with respect to changing grades. This was especially true for test weight, heat damage, and mold damage. Younger farmers (Group B) were more inclined than older farmers to include a factor for mold damage in future standards.

Data were not available to test either of two other hypothetical explanations for the lack of support for changing grade factors. One of these is the level and frequency of discounts related to variations in the quality of the crop from year to year. A second possible explanation is the belief by farmers that grade factor changes would always work to their detriment.

Changes in Attitudes over Time — Soybean Grades

Current Factors. As with corn, farmers' attitudes toward changing soybean grade factors showed no consistent pattern. The Illinois survey showed increased support between 1975 and 1986 for changing heat damage, total damage, and splits (Table 31). Iowa farmers showed the opposite trend. Test weight was the only factor for which farmers in both states were consistent—decreasing their support for change. Illinois farmers decreased their support for changing the factor of foreign material; Iowa showed a slight increase from 25.0 percent to 26.1 percent.

New Factors. The number of farmers ranking protein, oil, mold, and storage life as "of some importance" or "important" for future soybean grade factors declined between 1975 and 1986, for both Illinois and Iowa. The support for adding these factors into grades was higher in Iowa in 1975 than in Illinois. However, the decline in support in Iowa was much greater than in Illinois for all factors except storage life as shown in Table 32.

Summary

According to the 1986 survey, the majority of farmers still favor the current grades and standards. Increasing concerns about the quality problems in corn and soybeans were expressed in their remarks and appeals for change, but many farmers still believe that changes would be unfavorable to their economic interests. Among the factors they would like to see changed, BCFM in corn and splits in soybeans ranked the highest. There was evidence that farmers recognized that some changes might be to their disadvantage individually, but would benefit the industry as a whole. The best example was found in support by more than 50 percent of the respondents for legislative action to reduce foreign material in the market channel, despite their reluctance to make changes in grading practices at their individual point of sale. Farmers recognized that removal of all price differentials for quality, when applied to the entire industry, would affect prices and would not be a good strategy. A majority of farmers supported the use of discounts and price differentials as necessary to improve quality.

Appendix

Multipliers Used for Expanding Survey Results

Farms by acres harvested	1986 projection[b] number & percent		State census[c]	1986 FRI respondents	Multiplier
Illinois					
0[a]	1,764	2.12	1,845	1[d]	1,845.00
1–49	19,118	23.00	20,010	4	5,002.50
50–99	9,057	10.89	9,473	23	411.87
100–199	12,035	14.48	12,598	87	144.80
200–499	24,669	29.68	25,822	304	89.94
500–999	13,169	15.84	13,781	285	48.35
1000+	3,314	3.99	3,471	119	19.17
Total	83,126	100.00	87,000	823	
Iowa					
0[a]	2,045	2.11	2,300	1[d]	2,300.00
1–49	14,041	14.48	15,783	1[d]	15,783.00
50–99	8,297	8.56	9,330	4	2,332.50
100–199	20,216	20.84	22,716	52	436.85
200–499	39,317	40.54	44,189	344	128.46
500–999	11,177	11.52	12,557	259	48.48
1000+	1,890	1.95	2,125	97	21.91
Total	96,983	100.00	109,000	758	
Indiana					
0[a]	1,519	2.43	1,895	1[d]	1,895.00
1–49	21,722	34.70	27,066	11	2,895.00
50–99	9,560	15.17	11,910	21	565.14
100–199	9,017	14.40	11,232	86	130.60
200–499	12,892	20.59	16,060	218	73.67
500–999	6,127	9.78	7,629	160	47.68
1000+	1,771	2.83	2,208	65	33.97
Total	62,608	100.00	78,000	562	

[a] Zero category is difference between Total and sum of all other acreage categories.

[b] 1986 data was projected from U.S. census data of 1969 to 1982 by linear least squares projection from the U.S. census category "Total Cropland, Number of Farmers."

[c] Obtained by multiplying the 1986 State Census Total by the percentage in previous column.

[d] Actual number of FRI respondents in zero category is none. "Dummy" respondents were added to avoid division by zero in calculating the multiplier.

Table 1. On-Farm Grain Storage Capacity in Illinois, Iowa, and Indiana, 1972, 1977, 1986, and 1991 Intentions

	Metal bins		Ear corn cribs		Converted cribs		Silos[a]		Other		Total, all
	Mill bu	% of total	Mill bu	% of total	Mill bu	% of total	Mill bu	% of total	Mill bu	% of total	Mill bu
Illinois											
1972	485	49.1	322	32.6	113	11.5	56	5.7	11	1.1	987
1977	742	61.3	205	17.0	140	11.6	87	7.2	35	2.9	1,209
1986	988	72.9	123	9.1	96	7.1	92	6.8	56	4.1	1,355
1991[b]	1,066	73.7	125	8.7	96	6.6	97	6.7	62	4.3	1,446
Iowa											
1972	504	42.0	416	34.7	157	13.1	95	7.9	28	2.3	1,200
1977	939	55.0	428	25.1	110	6.4	149	8.7	81	4.8	1,707
1986	1,424	67.8	222	10.5	111	5.3	189	9.0	155	7.4	2,101
1991[b]	1,520	68.8	229	10.4	111	5.0	191	8.7	157	7.1	2,208
Indiana[c]											
1986	671	80.0	61	7.3	32	3.8	43	5.1	32	3.8	839
1991[b]	732	81.0	62	6.9	33	3.6	45	5.0	32	3.5	904

SOURCE: 1986 and 1991 data were calculated from expanded survey data. 1972 and 1977 data were taken from Hill and Vercimak (1979).

[a] Silo capacities were reported for storage of both high-moisture and dry shelled corn.

[b] Calculated by adding the 1986 actual capacity reported to the respondents' stated intent to add capacity within five years.

[c] Indiana data were not available for 1972 and 1977.

Table 2. Farmers Owning Dryers in Illinois, Iowa, and Indiana in 1986

	Illinois		Iowa		Indiana	
Dryer type and number	Number	Percent[a]	Number	Percent[a]	Number	Percent[a]
One dryer type						
Continuous flow	3,740	9.0	4,210	7.7	2,510	7.9
Batch	3,841	9.2	7,924	14.5	4,611	14.5
Bin						
Gas	20,624	49.5	31,343	57.2	16,038	50.4
Electric	1,422	3.4	2,757	5.0	2,507	7.9
No heat	3,317	8.0	4,405	8.0	482	1.5
Solar	315	0.8	437	0.8	0	0
Two or more dryer types	8,435	20.3	13,761	25.1	5,663	17.8
Total respondents owning dryers	41,694	100.0 (47.9)[b]	54,837	100.0 (55.4)[b]	31,811	100.0 (41.8)[b]
No dryer	45,304	(52.1)[b]	44,165	(44.6)[b]	44,294	(58.2)[b]
Total farmers responding	87,000	(100.0)[b]	99,002	(100.0)[b]	76,105	(100.0)[b]

SOURCE: Expanded survey data.

[a] Percents are calculated from the base number of farmers owning dryers.

[b] Percents in parentheses are calculated from the base of total number of farmers responding.

Table 3. Farmers Owning Dryers in Illinois in 1981 and 1986

	1981		1986	
Dryer type and number	Number	Percent[a]	Number	Percent[a]
One dryer type				
Continuous flow	3,351	7.2	3,740	9.0
Batch	4,273	9.2	3,841	9.2
Bin				
Gas	17,460	37.6	20,624	49.5
Electric	4,424	9.6	1,422	3.4
No heat	3,028	6.5	3,317	8.0
Solar	147	0.3	315	0.8
Not specified	1,766	3.8	0.0	0.0
Two or more dryer types	11,955	25.8	8,435	20.3
Total respondents owning dryers	46,404	100.0 (47.1)[b]	41,694	100.0 (47.9)[b]
No dryer	52,118	(52.9)[b]		(52.1)[b]
Total farmers responding	98,522	(100.0)[b]	87,000	(100.0)[b]

SOURCE: For 1986 data, survey results were expanded and weighted to represent state totals. Data for 1981 were taken from Hill, Brophy, and Florkowski (1979).

[a] Percents are calculated from the base number of farmers owning dryers.

[b] Percents in parentheses are calculated from the base of total number of farmers responding, expanded to the state total.

Table 4. Percentage of Dryers by Dryer Type on Farms in Illinois, Iowa, and Indiana, 1986

Dryer type	Illinois[a]	Iowa[b]	Indiana[c]
Continuous flow	11.2	9.9	9.5
Batch	10.2	14.7	18.1
Bin			
High temperature	53.2	53.2	54.3
Low temperature	25.4	22.2	18.1
All types	100.0	100.0	100.0

NOTE: Multiple units of the same dryer type are counted only once. The number of dryers exceeds the number of farmers with dryers because several farmers own two or more types of dryers.

[a] The total number of dryers on Illinois farms was 51,438.

[b] The total number of dryers on Iowa farms was 79,632.

[c] The total number of dryers on Indiana farms was 38,424.

Table 5. Corn Produced and Dried On-Farm in Illinois, Iowa, and Indiana, 1971, 1976, and 1986

	Production on-farm			Volume dried on-farm			Percent dried on-farm		
	1971	1976	1986	1971	1976	1986	1971	1976	1986
State	(million bushels)			(million bushels)			(percent)		
Illinois	1,110	1,246	1,637	377	523	798	34	42	49
Iowa	1,284	1,372	2,123	348	624	1,125	27	45	53
Indiana	534	693	926	192	367	537	36	53	58

SOURCE: Illinois and Iowa data for 1971 and 1976 were taken from Hill and Vercimak (1979). Indiana estimates for 1971 and 1976 were calculated from various issues of CORN: Harvesting, Handling, and Drying Methods, Illinois Cooperative Crop Reporting Service, Springfield, IL. Data for 1986 are calculated from expanded survey results.

Table 6. On-Farm Cleaning Practices in Illinois, Iowa, and Indiana, 1986 (percent of responses)

	Illinois	Iowa	Indiana
Cleaning corn or soybeans on farm			
Yes	35.9	37.3	39.9
No[a]	64.1	62.7	60.1
Timing of cleaning			
Before storing	85.9	87.0	81.0
Before selling	11.9	9.0	14.0
Other	2.2	4.0	5.0
Excess screenings			
Sold	9.1	9.3	10.3
Fed	60.6	79.0	66.4
Other	30.3	11.7	23.3
Cleaning equipment			
Auger screen in combine	29.7	25.7	30.1
Rotary cleaner	21.8	37.3	28.6
Screen section in auger	38.5	27.8	31.9
Other	10.0	9.3	9.4
Additional combine adjustments to deliver as much FM as allowed without discount			
Yes	12.4	8.0	9.5
No	66.5	69.4	58.5
No answer	25.2	22.6	32.0
Additional combine adjustments to deliver lowest possible amount of FM			
Yes	88.6	87.5	86.8
No	7.7	8.7	8.2
No answer	3.7	3.8	6.0
Different combine settings for grain stored on farm vs. grain sold to elevator			
Yes	4.6	3.8	4.5
No	92.5	92.9	95.1
No answer	2.9	3.3	0.4

[a] No answer or blank was considered a negative response to the question.

Table 7. Cleaning Technologies Used by Farmers in Illinois, Iowa, and Indiana, Based on Percent of On-Farm Storage, 1986 (percent of responses)

	Rotary cleaner			Screen in combine auger			Screen in loading auger			Other methods		
	Illinois	Iowa	Indiana	Illinois	Iowa	Indiana	Illinois	Iowa	Indiana	Illinois	Iowa	Indiana
Percent of corn stored on farm												
0–50 percent	4.1	8.8	10.8	9.8	7.2	10.8	10.2	7.2	12.7	4.1	4.8	2.5
50–75 percent	14.8	21.9	12.9	18.7	11.4	12.9	27.1	15.2	16.1	2.4	4.8	4.8
75–100 percent	15.0	21.0	20.2	18.2	15.0	20.2	24.2	15.7	22.0	6.5	4.7	7.0
Percent of beans stored on farm												
0–50 percent	8.4	15.6	14.2	12.3	10.2	14.2	15.7	10.2	13.6	5.4	4.4	4.7
50–75 percent	16.5	20.9	24.6	21.1	18.7	24.6	27.8	19.8	24.6	4.5	3.3	5.3
75–100 percent	15.2	24.1	20.0	19.4	16.0	20.0	25.6	18.7	29.0	5.7	5.8	7.6

NOTE: Percents are calculated using, as a base, the number of farmers who reported using a cleaner.

Table 8. Attitude of Farmers by Age and Education Toward Eliminating Discounts and Premiums in Illinois, Iowa, and Indiana, 1986

	Age		Education		
Response[a]	≤ 55 years	Over 55 years	≤ 12 years	Over 12 years	All farmers
			. . . percent . . .		
Yes					
Illinois	9.7	17.4	27.9	11.5	18.0
Iowa	9.1	13.3	18.4	9.6	13.8
Indiana	14.4	15.5	23.8	14.1	11.8
No					
Illinois	70.3	54.4	44.3	65.3	61.4
Iowa	70.1	68.6	62.1	70.6	68.3
Indiana	66.0	57.1	45.2	63.7	55.8
Uncertain					
Illinois	20.0	28.2	27.5	23.2	20.6
Iowa	20.8	18.1	19.5	19.8	17.9
Indiana	19.6	27.4	31.0	22.2	32.4

[a] Response to survey question: Do you favor eliminating all discounts and premiums?

Table 9. Percentage of Dryers Found on Each Farm Size in Illinois, Iowa, and Indiana, 1986

	Dryer Type			
Bushels dried	Continuous flow[a]	Batch[b]	Bin high temp[c]	Bin low temp[d]
Illinois				
0	7.6	10.6	5.1	12.5
1–999	0.0	0.0	0.0	0.0
1,000–4,999	8.6	10.6	11.3	15.1
5,000–9,999	8.0	8.1	17.9	12.4
10,000–24,999	24.2	43.3	39.2	28.3
25,000–49,999	31.5	18.2	20.3	24.8
50,000+	20.1	9.1	6.2	6.9
Total	100.0	100.0	100.0	100.0
Iowa				
0	12.0	1.4	3.5	6.5
1–999	0.0	0.0	0.0	0.0
1,000–4,999	0.0	5.2	11.7	7.1
5,000–9,999	7.1	14.4	25.0	29.1
10,000–24,999	34.9	53.9	36.6	40.2
25,000–49,999	28.4	20.5	18.4	13.3
50,000+	17.6	4.6	4.9	3.8
Total	100.0	100.0	100.0	100.0
Indiana				
0	0.9	8.1	4.8	6.4
1–999	0.0	1.9	0.0	8.1
1,000–4,999	2.0	4.8	23.5	8.6
5,000–9,999	6.0	16.9	20.5	23.1
10,000–24,999	23.8	30.7	32.8	34.6
25,000–49,999	26.7	31.0	14.8	14.7
50,000+	40.5	6.7	3.6	4.5
Total	100.0	100.0	100.0	100.0

NOTE: Size in this table is measured by bushels dried on-farm.

[a] Total continuous flow dryer count for Illinois was 5,774; for Iowa, 7,887; for Indiana, 3,656.

[b] Total batch dryer count for Illinois was 5,225; for Iowa, 11,721; for Indiana, 6,952.

[c] High-temperature bins use LP gas as their heat source. Total high-temperature bin count for Illinois was 27,385; for Iowa, 42,371; for Indiana 20,856.

[d] Low-temperature bins use electricity, no heat, or solar heat only. Total low-temperature bin count for Illinois was 13,053; for Iowa, 17,651; for Indiana, 6,961.

Table 10. Characteristics of Farmers Owning Each Type of Dryer in Illinois, 1986

	Dryer type				
Characteristic	Continuous flow	Batch	Bin high temp	Bin low temp	No dryer
			. . . percent . . .		
Age					
Below 55	59.2	57.3	55.5	47.6	35.1
55 and over	40.8	42.7	44.5	52.4	64.9
Education					
Through 11	8.4	1.9	11.6	13.9	24.2
12 +	91.6	98.1	88.4	86.1	75.8
Farm type					
Grain	70.0	57.0	61.2	65.2	59.7
Hogs	23.1	26.4	26.4	19.1	4.9
Other	7.0	16.6	12.4	15.7	35.4
Total acreage					
0	0.0	0.0	0.0	0.0	0.0
1–49	0.0	0.0	0.0	0.0	46.0
50–99	7.1	7.9	7.5	6.3	13.3
100–199	5.0	16.6	10.0	12.2	17.7
200–499	33.8	40.6	42.8	43.6	18.2
500–999	36.8	25.9	30.9	31.9	4.4
1000 +	17.2	8.9	8.7	6.0	0.4

Table 11. Characteristics of Farmers Owning Each Type of Dryer in Indiana, 1986

	Dryer type				
Characteristic	Continuous flow	Batch	Bin high temp	Bin low temp	No dryer
			. . . percent . . .		
Age					
Below 55	61.7	50.3	45.2	54.4	36.2
55 and over	38.3	49.7	54.8	45.6	63.8
Education					
Through 11	5.2	15.6	10.3	11.4	12.1
12 +	94.8	84.4	89.7	88.6	87.9
Farm type					
Grain	64.1	55.0	60.1	53.2	45.5
Hogs	31.3	24.2	24.1	29.0	8.7
Other	4.6	20.7	15.7	17.9	45.7
Total acreage					
0	0.0	0.0	0.0	0.0	0.0
1–49	0.0	0.0	11.8	0.0	55.6
50–99	0.0	8.2	13.6	16.3	19.2
100–199	3.6	15.0	18.2	18.7	12.7
200–499	32.2	44.5	33.2	37.1	9.8
500–999	32.6	24.0	19.7	24.0	2.4
1000 +	31.6	8.3	3.6	3.9	0.4

Table 12. Characteristics of Farmers Owning Each Type of Dryer in Iowa, 1986

Characteristic	Dryer type Continuous flow	Batch	Bin high temp	Bin low temp	No dryer
	. . . *percent* . . .				
Age					
Below 55	50.0	55.7	48.2	55.0	50.9
55 and over	50.0	44.3	51.8	45.0	49.1
Education					
Through 11	8.5	15.4	16.4	12.8	16.8
12 +	91.5	84.6	83.6	87.2	83.2
Farm type					
Grain	54.0	47.7	44.7	43.1	42.1
Hogs	42.7	41.0	44.2	44.1	22.6
Other	3.3	11.3	11.1	12.8	35.3
Total acreage					
0	0.0	0.0	0.0	0.0	0.0
1–49	0.0	0.0	0.0	0.0	0.0
50–99	0.0	0.0	11.0	0.0	17.9
100–199	16.6	18.6	18.6	17.3	40.2
200–499	45.6	61.4	49.4	63.3	36.0
500–999	28.9	17.4	18.0	16.8	5.2
1000 +	8.9	2.6	3.1	2.6	0.7

Table 13. Variables Influencing the Percent of Corn Dried on Farms in illinois, Iowa, and Indiana, 1986

State	Constant	VPS	PSF	Independent variables[a] Age	ED	GRN	LVS	No.	R^2
Illinois	.26*	−.04*	.74*	−.005*	−.006*	.35*	.25*	583	.43
Iowa	−.43*	−.03*	.72*	.0002	.02*	.39*	.30*	582	.24
Indiana	.60*	−.14*	.39*	.002*	.004*	.16*	.16*	364	.44

NOTE: Values in the tables are the b-values obtained from OLS regression. R^2 is the adjusted R^2.

[a] VPS = value of products sold; PSF = percent of corn production stored on-farm; Age = age of farm operator; ED = education level of farm operator (if over 12 years of education, ED = 1; otherwise, ED = 0); GRN = grain farm where grain sales were over 50% of gross income (dummy variable); LVS = livestock farm producing more than 100 head of hogs (dummy variable).

* Significant at p = .01.

Table 14. Probability of Purchasing Low-Temperature Dryers in Response to Premiums Paid for Higher Quality, 1986 (percent of all farmers)

	Purchase probability					
Premium/bu	Zero	1–20%	21–40%	41–60%	61–80%	81–100%
Illinois						
1 cent	95.2	3.8	0.6	0	0	0.4
5 cents	79.8	13.2	4.7	1.8	0.2	0.5
10 cents	64.1	10.2	11.7	8.8	3.5	1.7
25 cents	57.7	4.5	6.4	9.7	8.9	12.9
Iowa						
1 cent	95.0	3.2	0.5	0.1	0	1.2
5 cents	78.6	14.2	3.4	2.2	0	1.6
10 cents	63.6	10.2	11.6	7.9	3.3	3.8
25 cents	57.1	5.6	5.6	9.4	7.0	15.1
Indiana						
1 cent	96.9	1.9	0.7	0	0.1	0.4
5 cents	87.7	7.4	2.5	1.7	0.2	0.6
10 cents	71.6	6.0	12.7	5.2	3.4	1.1
25 cents	67.7	3.3	2.2	8.7	8.9	9.3

NOTE: In this table the cumulative effect of sequentially higher premiums is not included in the percents. For example, the 3.8% of Illinois farmers reporting a 1-20% probability of buying a dryer for a premium of only 1 cent per bushel would logically also buy a dryer if the premium were raised to 10 or 25 cents. The percents are not cumulative in this table.

Table 15. Supply Response to Premiums for Low-Temperature Dried Corn (millions of bushels)

Premium level	Predicted expansion[a]	Already available	Total
Illinois			
1 cent	0	103.3	103.3
5 cents	0	103.3	103.3
10 cents	73.6	103.3	176.9
25 cents	301.0	103.3	404.3
Iowa			
1 cent	6.4	136.8	143.2
5 cents	14.9	136.8	151.7
10 cents	75.4	136.8	212.2
25 cents	330.1	136.8	446.9
Indiana			
1 cent	1.4	42.7	44.1
5 cents	5.2	42.7	47.9
10 cents	46.6	42.7	89.3
25 cents	202.6	42.7	245.3

NOTE: Predicted increase is calculated from a 60–100% probability of purchase in response to hypothetical premiums of 1, 5, 10, or 25 cents per bushel.

[a] Several farmers with low-temperature dryers recorded a 60–100% probability of purchase. This was assumed to be a replacement of existing equipment and, therefore, was not counted as an expansion in volume dried. For example, there are zero entries for the 1 cent premium for Illinois, even though 0.4 percent of Illinois respondents reported an 81–100% probability of purchase as indicated in Table 14. These respondents already had a low-temperature dryer.

Table 16. Influences of Selected Factors on the Purchase of Low-Temperature Dryers in Illinois, Indiana, and Iowa, 1986

Variable name	Unit	Iowa	Indiana	Illinois
Income	0/1	.2198	.2122	.5013*
		(1.60)	(1.20)	(3.31)
Farm type	0/1	.0550	.2737*	.1650*
		(1.12)	(4.42)	(3.05)
Age	years	−.0268*	−.0328*	−.0291*
		(−4.09)	(−4.78)	(−4.96)
Premium	cents	.1016*	.1468*	.1495*
		(8.40)	(6.51)	(8.08)
Constant	—	−.5411	−2.9846*	−2.4665*
		(−.93)	(−4.01)	(−3.45)
Chi-square		170.90	246.26	304.27

NOTE: Coefficients were estimated by an ordered-response model. Numbers in parentheses are the values of the t-statistic. Results for a sample with missing observations are set to zero, i.e., those who did not respond are assumed to have a zero probability of purchase at any premium.

* Significant at p = .01.

Table 17. Farmer Attitudes Toward Current Grade Factors for Corn, 1986

Current grade factors	Percentage favoring			
	Keep	Change	Remove	Remove or change
BCFM				
Illinois	68.6	21.0	10.4	31.4
Iowa	60.5	33.7	5.8	39.5
Indiana	57.7	34.7	7.6	42.1
Heat damage				
Illinois	75.3	21.3	3.4	24.7
Iowa	82.6	13.9	3.5	17.4
Indiana	80.7	15.7	3.6	19.3
Total damage				
Illinois	80.4	16.5	3.1	19.6
Iowa	74.9	22.9	2.2	25.1
Indiana	77.3	20.2	2.5	22.7
Test weight				
Illinois	91.3	5.4	3.3	8.7
Iowa	87.1	8.7	4.2	12.9
Indiana	89.4	5.4	5.2	10.6

Table 18. Farmer Attitudes Toward Current Grade Factors for Soybeans, 1986

Current grade factors	Percentage favoring			
	Keep	Change	Remove	Remove or change
Test weight				
Illinois	89.4	5.7	4.9	10.6
Iowa	84.5	9.4	6.1	15.5
Indiana	88.4	5.9	5.7	11.6
Splits				
Illinois	44.0	22.5	33.5	56.0
Iowa	54.7	26.1	19.2	45.3
Indiana	54.9	19.3	25.8	45.1
Foreign material				
Illinois	77.4	21.1	1.5	22.6
Iowa	73.9	24.6	1.5	26.1
Indiana	74.0	22.8	3.2	26.0
Heat damage				
Illinois	73.3	23.1	3.6	26.7
Iowa	84.7	10.8	4.5	15.3
Indiana	84.7	10.3	5.0	15.3
Total damage				
Illinois	78.8	7.8	3.4	21.2
Iowa	75.2	22.7	2.1	24.8
Indiana	78.0	20.4	1.6	22.0

Table 19. Percentage of Farmers Reporting Different Levels of Sales of Corn Discounted for BCFM, 1986

State	Percent of sales discounted					
	0%	1–4%	5–25%	26–50%	Over 50%	Total
Illinois	57.5	35.8	6.2	0.2	0.3	100.0
Iowa	58.9	34.4	4.2	0.6	1.9	100.0
Indiana	60.8	21.8	17.0	0.2	0.2	100.0

Table 20. Effect of Frequency of Discounts on Farmer Attitudes Toward Changing the BCFM Factor for Corn, Three States Combined, 1986

	Group 1 (less than 5% discounted)			Group 2 (5% or more discounted)			
	Actual responses	Expected value	% Actual responses	Actual responses	Expected value	% Actual responses	Total farmers
Keep	982	970	61.3	38	50	46.3	1020
Change	146	148	9.1	10	8	12.2	156
Remove	473	482	29.5	34	25	41.5	507
Total	1601	1601	99.9[a]	82	82	100.0	1683

[a] Total percent differs from 100.0 due to rounding.

Table 21. Percentage of Farmers Reporting Different Levels of Sales of Soybeans Discounted for FM, 1986

	Percent of sales discounted					
State	0%	1–4%	5–25%	26–50%	Over 50%	Total
Illinois	43.5	47.0	6.0	0.6	2.9	100.0
Iowa	63.6	27.9	5.9	1.3	1.3	100.0
Indiana	39.3	45.5	10.0	2.4	2.8	100.0

Table 22. Effect of Frequency of Discounts on Farmer Attitudes Toward Changing the FM Factor for Soybeans, Three States Combined, 1986

	Group 1 (less than 5% discounted)			Group 2 (5% or more discounted)			
	Actual responses	Expected value	% Actual responses	Actual responses	Expected value	% Actual responses	Total farmers
Keep	1042	1025	74.0	150	174	65.5	1192
Change	30	34	2.1	10	6	4.4	40
Remove	336	348	23.9	69	59	30.1	405
Total	1408	1408	100.0	239	239	100.0	1637

Table 23. Ranking of Additional Grade Factors for Corn by Percent of Respondents, 1986

Suggested additional grade factors	Very important	Of some importance	Unimportant	Total
Protein				
Illinois	46.5	39.7	13.8	100.0
Iowa	41.3	40.3	18.4	100.0
Indiana	32.3	41.0	26.7	100.0
Starch				
Illinois	33.7	40.3	26.0	100.0
Iowa	21.2	47.6	31.2	100.0
Indiana	32.8	35.0	32.2	100.0
Oil				
Illinois	33.9	34.9	31.2	100.0
Iowa	20.4	33.8	45.8	100.0
Indiana	29.4	29.3	41.3	100.0
Mold				
Illinois	66.4	29.6	4.0	100.0
Iowa	64.7	25.3	10.0	100.0
Indiana	55.4	28.4	16.2	100.0
Stress cracks				
Illinois	8.5	50.6	40.9	100.0
Iowa	9.3	50.1	40.6	100.0
Indiana	14.3	49.1	36.6	100.0
Storage life				
Illinois	34.9	29.5	35.6	100.0
Iowa	28.0	46.0	26.0	100.0
Indiana	36.7	35.0	28.3	100.0
Brittleness				
Illinois	9.5	51.7	38.8	100.0
Iowa	10.3	40.4	49.3	100.0
Indiana	15.0	42.8	42.2	100.0

Table 24. Ranking of Additional Grade Factors for Soybeans by Percent of Respondents, 1986

Suggested additional grade factors	Very important	Of some importance	Unimportant	Total
Protein				
Illinois	51.8	30.4	17.8	100.0
Iowa	55.8	28.4	15.8	100.0
Indiana	41.6	36.3	22.1	100.0
Starch				
Illinois	10.6	39.0	50.4	100.0
Iowa	8.8	34.8	56.4	100.0
Indiana	9.7	37.2	53.1	100.0
Oil				
Illinois	56.8	28.5	14.7	100.0
Iowa	56.3	29.6	14.1	100.0
Indiana	51.9	28.8	19.3	100.0
Mold				
Illinois	61.4	28.7	9.9	100.0
Iowa	60.0	28.7	11.3	100.0
Indiana	49.3	35.6	15.1	100.0
Stress cracks				
Illinois	6.4	42.4	51.2	100.0
Iowa	8.2	49.0	42.8	100.0
Indiana	10.9	41.6	47.5	100.0
Storage life				
Illinois	18.8	38.6	42.6	100.0
Iowa	28.5	43.2	28.3	100.0
Indiana	30.8	40.8	28.4	100.0
Brittleness				
Illinois	7.8	48.7	43.5	100.0
Iowa	7.8	40.4	51.8	100.0
Indiana	10.5	45.0	44.5	100.0

Table 25. Preferences of Illinois, Iowa, and Indiana Farmers for Alternatives for Reducing Foreign Material in Corn and Soybeans, 1986

Alternatives	Illinois	Iowa	Indiana
Legislative prohibition against blending and introduction of FM	52.5	62.3	59.1
Premium (subsidy) for FM below contract grade	53.2	51.8	48.2
Lower allowable limits in the standard for FM	8.9	10.7	9.5
Raise discounts without changing grade limits	6.9	4.8	6.9
Separation of BC and FM[a]	32.2	33.9	30.1
No change in current system	0.0	0.0	21.8

NOTE: Respondents were allowed to check more than one alternative.

[a] A check for "discount per point for FM above 0 percent," or for "discount per point for FM above _____ percent," or any discount recorded in the question, was counted as support for the separation of BC and FM.

Table 26. Maximum Limit for FM Without Discount Suggested by Farmers Who Recommended Separating BC from FM, 1986

	Illinois		Iowa		Indiana	
Factor limit	Number	Percent	Number	Percent	Number	Percent
0	84	31.7	97	37.7	70	41.4
0.5	4	1.5	2	0.8	4	2.4
1	41	15.5	40	15.6	29	17.2
1.5	5	1.9	2	0.8	2	1.2
2	54	20.4	44	17.1	26	15.4
3	32	12.1	26	10.1	16	9.5
4	6	2.3	9	3.5	3	1.8
5	38	14.3	33	12.8	19	11.2
6	0	0.0	1	0.4	0	0.0
7	1	0.4	3	1.2	0	0.0
Total	265	100.1[a]	257	100.0	169	100.1[a]

[a] Total percent differs from 100.0 due to rounding.

Table 27. Percentage of Farmers Favoring Changing or Removing Corn Grade Factors in Illinois and Iowa, 1975, 1981, and 1986

Grading factor	1975	1981	1986
Moisture			
Illinois	25.0	30.0	—[a]
Iowa	31.0	—[b]	—[a]
Test weight			
Illinois	32.0	35.0	8.7
Iowa	33.0	—[b]	12.9
Heat damage			
Illinois	12.0	24.0	24.7
Iowa	19.0	—[b]	17.4
Total damage			
Illinois	20.0	46.0	19.6
Iowa	23.0	—[b]	25.1
BCFM			
Illinois	32.0	56.0	31.4
Iowa	39.0	—[b]	39.5

SOURCE: Zhang, Hill, and Brophy, 1989.

[a] Removed as a grade factor in September, 1985.

[b] No survey was conducted in Iowa in 1981.

Table 28. Percentage of Farmers Ranking Additional Corn Quality Factors of Some Importance or Very Important in Illinois and Iowa, 1975, 1981, and 1986

Suggested additional grade factors	1975	1981	1986
Protein			
Illinois	93.0	73.4	86.2
Iowa	92.0	—[a]	81.6
Starch			
Illinois	88.0	66.5	74.0
Iowa	88.0	—[a]	54.2
Oil			
Illinois	85.0	—[a]	68.8
Iowa	81.0	—[a]	54.2
Mold			
Illinois	96.0	74.0	96.1
Iowa	98.0	—[a]	90.0
Stress cracks			
Illinois	72.0	56.9	59.1
Iowa	75.0	—[a]	59.4
Storage life			
Illinois	83.0	—[a]	64.4
Iowa	85.0	—[a]	74.0
Brittleness			
Illinois	—[a]	—[a]	61.8
Iowa	—[a]	—[a]	50.7

SOURCE: Zhang, Hill, and Brophy 1989.

[a] No survey was conducted in Iowa in 1981.

Table 29. Shifts in Attitude Between 1981 and 1986 Toward Changes in Corn Grade Factors for a Matched Subset of Illinois Farmers

Grade factors	Same attitude[a]	Less favorable[b]	More favorable[c]	Missing data
		. . . percent . . .		
Current factors				
Test weight	58.7	28.2	13.1	0.8
Heat damage	53.1	29.2	17.7	1.5
Total damage	42.3	30.5	27.2	2.0
BCFM	39.5	31.5	29.0	1.5
Suggested factors				
Mold	36.5	40.6	22.9	2.3
Stress cracks	36.4	33.4	28.0	1.8
Protein	38.0	24.6	37.4	1.8
Starch	40.6	23.7	35.7	1.8

SOURCE: Calculated from expanded survey data.

[a] Includes keep-keep, change-change, or remove-remove for current grade factors; important-important, unimportant-unimportant, or of some importance-of some importance for suggested factors for both years.

[b] Includes change-keep, remove-change for current grade factors; important-of some importance, of some importance-unimportant for suggested grade factors for both years.

[c] Includes keep-change, change-remove for current factors; unimportant-of some importance, of some importance-important for suggested factors for both years.

Table 30. Comparison of Attitude Shifts Toward Changes in Corn Grades Between Long-Term and New Panel Members

	Long-term members[a]				New members[b]			
Grade factors	Keep	Change	Remove	Missing data	Keep	Change	Remove	Missing data
				. . . percent . . .				
Current factors								
Test weight	79.8	6.3	7.3	6.6	82.6	6.1	5.2	6.1
Heat damage	73.2	4.0	12.9	9.8	74.4	3.1	13.1	9.4
Total damage	62.4	2.3	19.4	15.9	67.8	1.4	19.5	11.3
BCFM	51.8	7.3	26.0	14.9	57.5	8.7	25.6	8.2
Suggested factors								
Protein	32.8	38.1	18.2	10.9	33.3	35.0	21.8	9.9
Starch	24.0	41.4	23.0	11.6	24.9	36.9	27.9	10.3
Mold	47.0	34.6	6.8	11.6	51.2	28.2	8.9	11.7
Stress cracks	12.4	47.2	28.0	12.4	16.2	39.9	33.3	10.6

SOURCE: Calculated from expanded survey data.

NOTE: Attitude shifts between 1981 and 1986.

[a] Respondents to the 1981 and 1986 surveys.

[b] Respondents to the 1986 survey only.

Table 31. Percentage of Farmers in Illinois and Iowa Favoring Changing or Removing Soybean Grade Factors, 1975 and 1986

Grading factor	1975	1986
Moisture		
Illinois	26.0	—[a]
Iowa	9.0	—[a]
Test weight		
Illinois	27.0	10.6
Iowa	27.0	15.5
Heat damage		
Illinois	11.0	26.7
Iowa	16.0	15.3
Total damage		
Illinois	19.0	21.2
Iowa	25.0	24.8
Foreign material		
Illinois	26.0	22.5
Iowa	25.0	26.1
Splits		
Illinois	45.0	56.0
Iowa	57.0	45.3

SOURCE: Zhang, Hill, and Brophy 1989.

[a] Removed as a grade factor in September, 1985.

Table 32. Percentage of Farmers in Illinois and Iowa Ranking Additional Soybean Quality Factors of Some Importance or Very Important, 1975 and 1986

Suggested additional grade factors	1975	1986
Protein		
Illinois	92	82.2
Iowa	95	84.2
Oil		
Illinois	95	85.3
Iowa	96	85.9
Mold		
Illinois	97	90.1
Iowa	98	88.7
Storage life		
Illinois	79	57.4
Iowa	81	71.7

SOURCE: Zhang, Hill, and Brophy (1989).

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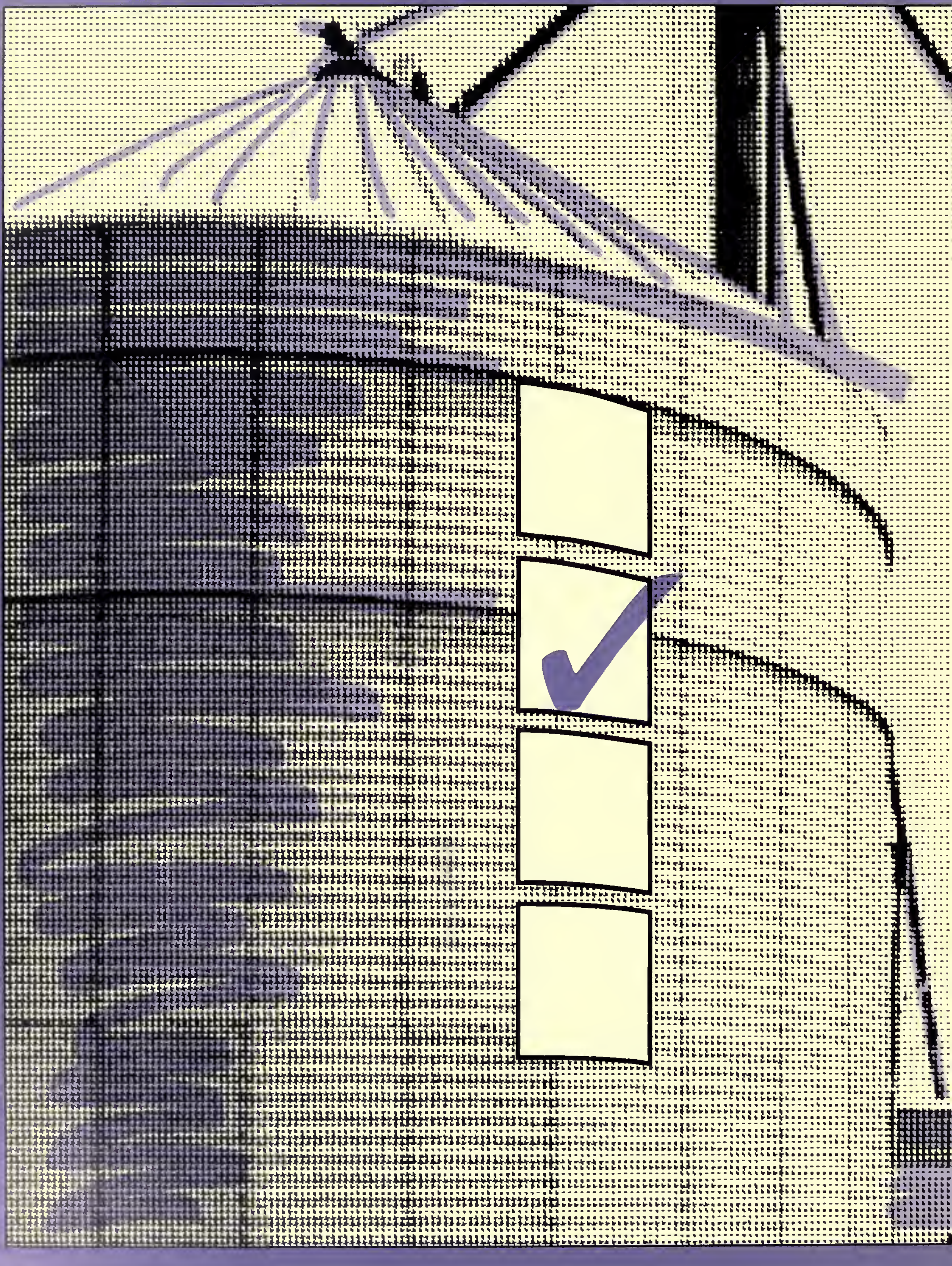

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